KEITHLEY INSTRUMENTS

Megohmmeters

Models 500, 501

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INSTRUCTION MANUAL

MODELS 500, 501

MEGOHMMETERS

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MANUAL # 1

WARRANTY

We warrant each of our products to be free from defects in material and workmanship. Our obligation under this warranty is to repair or replace any instrument or part thereof (except tubes and batteries) which, within a year after shipment, proves defective upon examination. We will pay domestic surface freight costs.

To exercise this warranty, call your local field representative or the factory, DDD 216-248-0400 You will be given assistance and shipping instructions.

REPAIRS AND RECALIBRATION

Keithley Instruments maintains a complete repair service and standards laboratory in Cleveland, and has an authorized field repair facility in Los Angeles.

To insure prompt repair or recalibration service, please contact your local field representative or the plant directly before returning the instrument.

Estimates for repairs, normal recalibrations, and calibrations traceable to the National Bureau of Standards are available upon request.

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SECTION I - INTRODUCTION

The Keithley Model 500 and 501 Megohmmeters are portable, self-contained megohmmeters of extreme range.

The Model 500 measures resistances from 10 megohms to 10 million megohms and the Model 501 measures from 10,000 ohms to 10,000 megohms. The meter is calibrated directly in megohms. The unknown resistance is connected to the instrument thru a UHF type connector. This facilitates checking of cables. A probe is included for making point-to-point measurements.

Either model may be used with the Model 5001 Eveready Carrying Case. This provides a protective cover for the instrument and a storage compartment for the probe.

SECTION II - SPECIFICATIONS

SPEFICICATIONS

RANGE:
500: 10^7 to 10^{13} ohms on single log scale.
501: 10^4 to 10^{10} ohms on single log scale.

ACCURACY: ±20% of reading.

WARM-UP TIME: 30 seconds.

DRIFT: Negligible after warm-up.

TEST POTENTIAL: Model 500: 8 volts; Model 501: 1.5 volts.

RISE TIME:(10% to 90%): Model 500 measures 10^{11} ohms shunted by 600 picofarads in 2 seconds. Model 501 measures 10 megohms shunted by one microfarad in 2 seconds. Rise time calculated:

$$T = \frac{RC}{4E}$$; E is 1.5 volts (Model 501) or 8 volts (Model 500).

CALIBRATION: Internal resistance standards for 2-point calibration with front panel controls.

CONNECTORS: Teflon-insulated UHF type.

BATTERIES:
Model 500: One RM12R (1.3 v), one TR146X (8v).
Model 501: One RM12R (1.3 v), two TR146X (8v).
Battery Life: 360 hours minimum.

DIMENSIONS, WEIGHT: 6 inches high x 3 inches wide x 2-1/8 inches deep; net weight, 1-1/2 pounds.

SECTION III - OPERATION

For resistance measurements of resistors, capacitors, printed circuits or any item with fixed terminals use the accessory probe. Connect the tip of the probe to the high impedance or well-insulated terminal of the unknown resistance and the clip lead (which is connected electrically to the case of the instrument) to the low impedance or ground terminal of the unknown. Switch the instrument from OFF to CALIBRATE 10 on the Model 500 or CALIBRATE .01 on the Model 501. Use the left-hand calibrate control to set the meter to 10 or 0.01. Then switch to CALIBRATE 10K on the Model 500 or 100 on the 501, and set the meter to 10K or 100 with the right-hand calibrate control. After calibrating the instrument, switch to READ. When there is appreciable capacitance in the circuit, allow sufficient time before taking the reading. See Response Speed in Section II.

The meter scale is marked with decade values; intermediate values of 2X and 5X are indicated by dots. These dots are numbered on the first decade only. On the Model 500 they are 20 and 50 megohms and on the Model 501 they are .02 and .05 megohms. Note that with the logarithmic scale, the rated accuracy of 20% holds for any meter reading.

When measuring leakage in shielded cables, remove the probe and attach the cable directly to the UHF input connector. If the cable is not terminated with a UHF plug, or if no adapter is available, the probe may be used; contact the inner conductor of the cable with the probe tip and connect the clip to the outside braid.

SECTION IV - CIRCUIT DESCRIPTION

These instruments make use of the fact that the grid potential of the 5886 in the Model 500, or 6418 in the Model 501, is proportional to the logarithm of the grid current when the grid is positive with respect to the cathode. The plate current, which is proportional to the grid potential, is indicated by the meter in the cathode circuit. Since the grid current is determined by the unknown resistance and the test voltage, the meter will indicate the logarithm of the unknown resistance when properly calibrated.

Two controls and two standard resistors are provided to calibrate the instrument. In the Model 500, the controls are R7-CAL 10K and R8-CAL 10; the standards are R1-10 megohm and R2-10 kilomegohm. In the Model 501, the controls are R8-CAL 100 and R9-CAL 0.01; the standards are R1-100 megohm and R2-10K (0.01 megohm).

When the instrument is switched from OFF to the first calibrate position, the lower value standard is connected across the circuit input. This causes a certain grid current to flow, biasing the grid so that maximum plate current flows. The current from the first calibrate potentiometer (R8 in the Model 500; R9 in the Model 501) is adjusted to equal the plate current and, since it opposes the plate current in the meter, the net meter current is zero.

When the switch is moved to the second calibrate position, the larger standard is connected in the circuit, reducing the grid current and biasing the grid more negative. The plate current is reduced, and the buck-out current from the first calibrate potentiometer causes the meter to read up-scale. The exact reading is set by the second calibrate control (R7 in the Model 500; R8 in the Model 501) which shunts the meter. Thus the meter scale is fitted to the tube characteristics at two points. Since the first calibrate control affects the setting of the second control, they should be adjusted in the proper order.

In the Model 500, the test voltage is derived from the plate battery B-2, and is about 8 volts. In the Model 501, the test voltage is derived from the filament battery B-1. It is listed as 1.5 volts but the actual test voltage is more properly one-half the battery voltage or about 0.7 volts.

SECTION V - MAINTENANCE

The insulation of the input connector and the probe should be kept clean to avoid leakage errors, particularly in the Model 500.

The batteries will require periodic replacement. As long as the instrument will calibrate properly, the batteries are satisfactory. To replace the batteries, remove the screw on the bottom of the case and remove the cover. The battery types and service life are as follows:

Model	Battery Type	No. Required	Hours - Life
500	RM 12R	1	360
	TR146X	1	2000
501	RM 12R	1	360
	TR146X	2	800

The type numbers are for Mallory batteries - equivalent units of other manufacturers may be used. Observe the polarity markings when replacing units.

The single tube in the instrument should give several thousand hours life. If replacement becomes necessary, refer to the schematic, Drawing 14051-C for installation. In handling the tube, do not touch the press -- contamination will cause excessive surface leakage. The tubes are selected and should be ordered from Keithley Instruments, Inc., using the number given on the schematic (5886-7 for Model 500; 6418-2 for Model 501).

SECTION 6. REPLACEABLE PARTS

6-1. REPLACEABLE PARTS LIST. The Replaceable Parts List describes the components of the Models 500 and 501 (and their accessories). Unless otherwise indicated, all listed parts are for both Models. The List gives the circuit designation, the parts description, a suggested manufacturer, the manufacturer's part number and the Keithley Part Number. The name and address of the manufacturers listed in the "Mfg. Code" column are in Table 2.

6-2. HOW TO ORDER PARTS.

a. For parts orders, include the instrument's model and serial number, the Keithley Part Number, the circuit designation and a description of the part. All structual parts and those parts coded for Keithley manufacture (80164) must be ordered through Keithley Instruments, Inc. or its representatives. In ordering a part not listed in the Replaceable Parts List, completely describe the part, its function and its location.

amp	amperes	M	mega (10^6)
CbV	Carbon Variable	Ω	ohm
Comp	Composition		
CompV	Composition Variable	p	pico (10^{-12})
DCb	Deposited Carbon	μ	micro (10^{-6})
f	farad	v	volts
k	kilo (10^3)		

TABLE 1. Abbreviation and Symbols.

REPLACEABLE PARTS LIST - MODEL 500

Circuit Desig.	Description	Mfg. Code	Keithley Part No.
B1	Battery, 1.35 V (Vendor No. RM12R)	37942	BA-7
B2	Battery, 8V (Vendor No. TR146X)	37942	BA-9
M	Meter, 50 μa	80164	ME-10
V-1	Vacuum Tube, 5886	80164	EV-5886-5X
	Switch, 3 pole, 4 position	80164	SW-40

Resistors

Circuit Desig.	Value	Rating	Type	Mfg. Code	Keithley Part No.
R1	10MΩ	1%, 1/2 w	DCb	01661	R12-10M
R2	10^{10}Ω	2%	Glass DCb	63060	R20-10^{10}
R3	100KΩ	10%, $\frac{1}{2}$ w	Comp	44655	R1-100K
R4	10KΩ	10%, $\frac{1}{2}$ w	Comp	44655	R1-10K
R5	1KΩ	1%, $\frac{1}{2}$ w	DCb	00686	R12-1K
R6	3.9KΩ	1%, $\frac{1}{2}$ w	DCb	00686	R12-3900
R7	10KΩ	20Ω, $\frac{1}{10}$ w	CbV	71590	RP14-10K
R8	2.5KΩ	20%, $\frac{1}{10}$ w	CbV	71590	RP14-2.5K
R9	10Ω	1%, $\frac{1}{2}$ w	DCb	01661	R12-10

REPLACEABLE PARTS LIST - MODEL 501

Circuit Desig.	Description	Mfg. Code	Keithley Part No.
B1	Battery, 1.35 V (Vendor No. RP12R)	37942	BA-7
B2	Battery, 8.4 V (Vendor No. TR146X)	37942	BA-9
B3	Battery, 8.4 V (Vendor No. TR146X)	37942	BA-9
C1	Capacitor, 510 pf, 500 V, Polystyrene tubular	71590	C138-510P
M	Meter, 50 μa	80164	ME-11
V1	Vacuum Tube, 6418-2	80164	EV6418-2
	Switch, 3 pole, 4 position	80164	SW-44

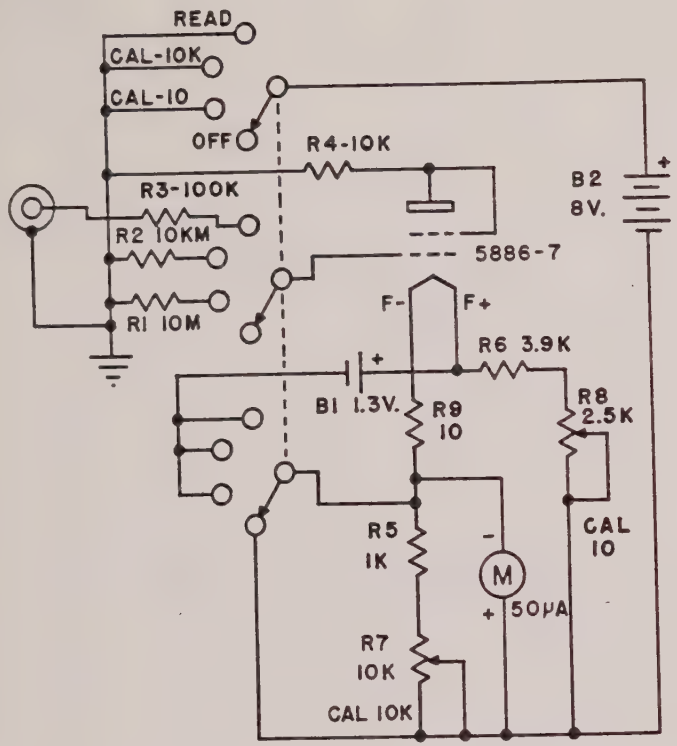
Resistors

Circuit Desig.	Value	Rating	Type	Mfg. Code	Keithley Part No.
R1	100MΩ	1%, 2 W	DCb	00327	R14-100M
R2	10KΩ	1%, $\frac{1}{2}$ w	DCb	01661	R12-10K
R3	22KΩ	10%, $\frac{1}{2}$ w	Comp	01121	R1-22K
R4	5KΩ	1%, $\frac{1}{2}$ w	DCb	00327	R12-5K
R5	700Ω	1%, $\frac{1}{2}$ w	DCb	01661	R12-700
R6	1.5KΩ	1%, $\frac{1}{2}$ w	DCb	00327	R12-1.50K
R7	500Ω	1%, $\frac{1}{2}$ w	DCb	01661	R12-500
R8	500Ω	20%, $\frac{1}{10}$ w	CbV	71590	RP14-500
R9	1KΩ	20%, $\frac{1}{10}$ w	CbV	71590	RP14-1K

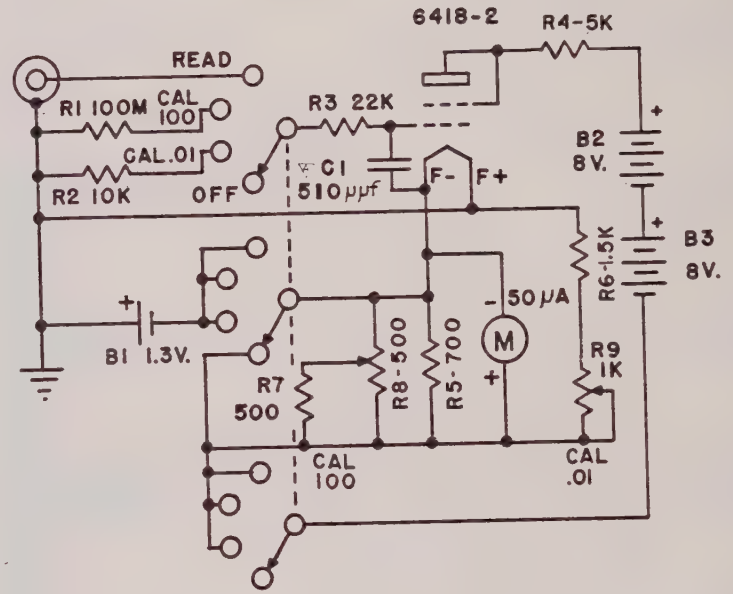
MANUFACTURERS' CODE DEFINITIONS

00327	Welwyn International, Inc. Cleveland, Ohio	44655	Ohmite Mfg. Co. Los Angeles, Calif.
00686	Film Capacitors, Inc. New York, N. Y.	63060	Victoreen Instrument Co. Cleveland, Ohio
01121	Allen Bradley Co. Milwaukee, Wisc.	71590	Centralab Division of Globe Union, Inc. Milwaukee, Wisconsin
01661	Wilrite Products, Inc. Cleveland, Ohio	80164	Keithley Instruments, Inc. Cleveland, Ohio
37942	Mallory, R. R., and Co. Indianapolis, Indiana		

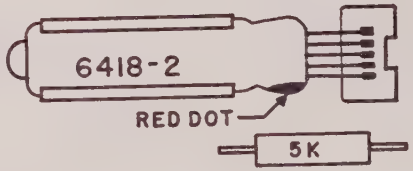
TABLE 2. Code List of Suggested Manufacturers. (Based on Federal Supply Code for Manufacturers, Cataloging Handbook H4-1).



MODEL 500 SCHEMATIC DIAGRAM



MODEL 501 SCHEMATIC DIAGRAM



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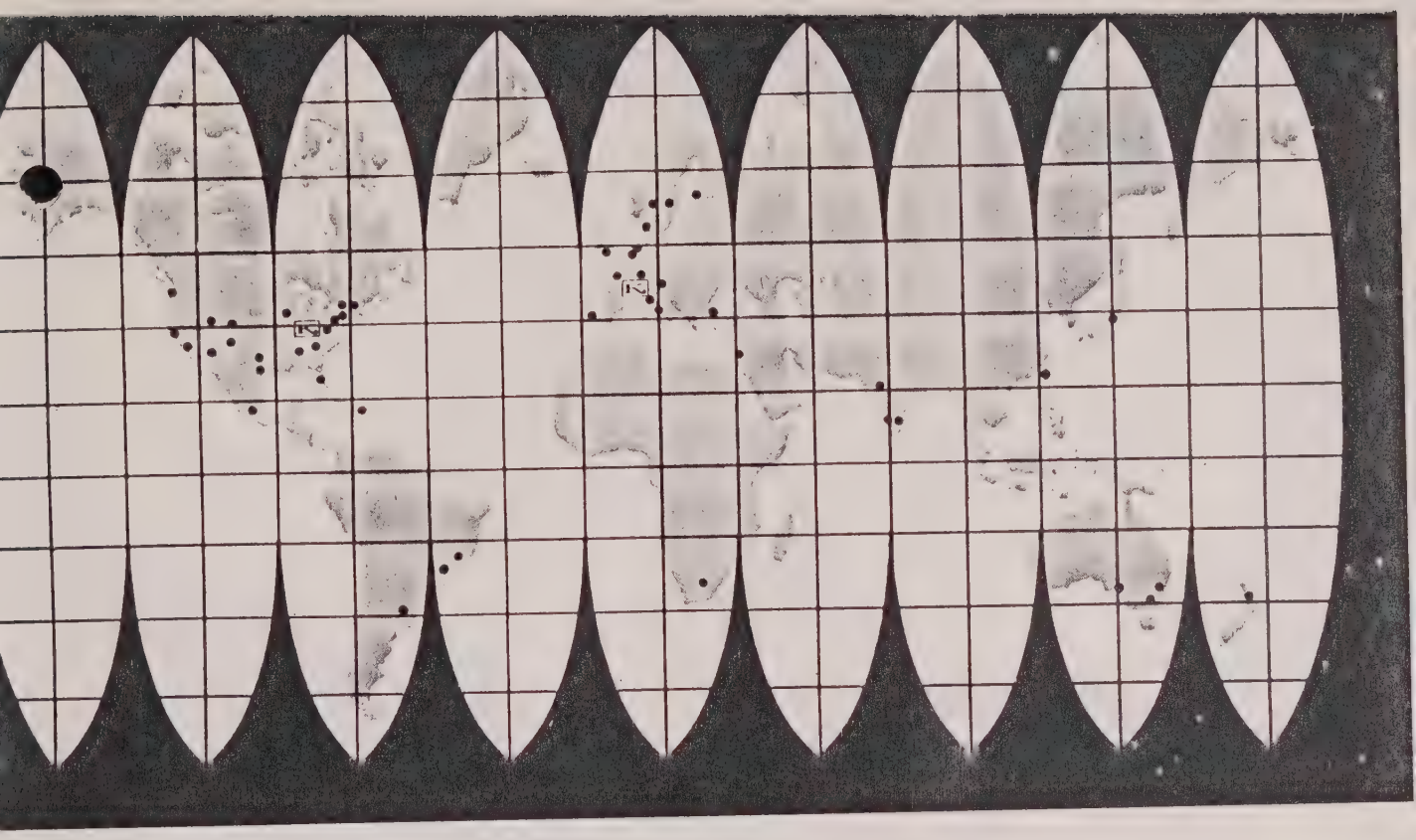

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Buenos Aires

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Tel. 42-4757

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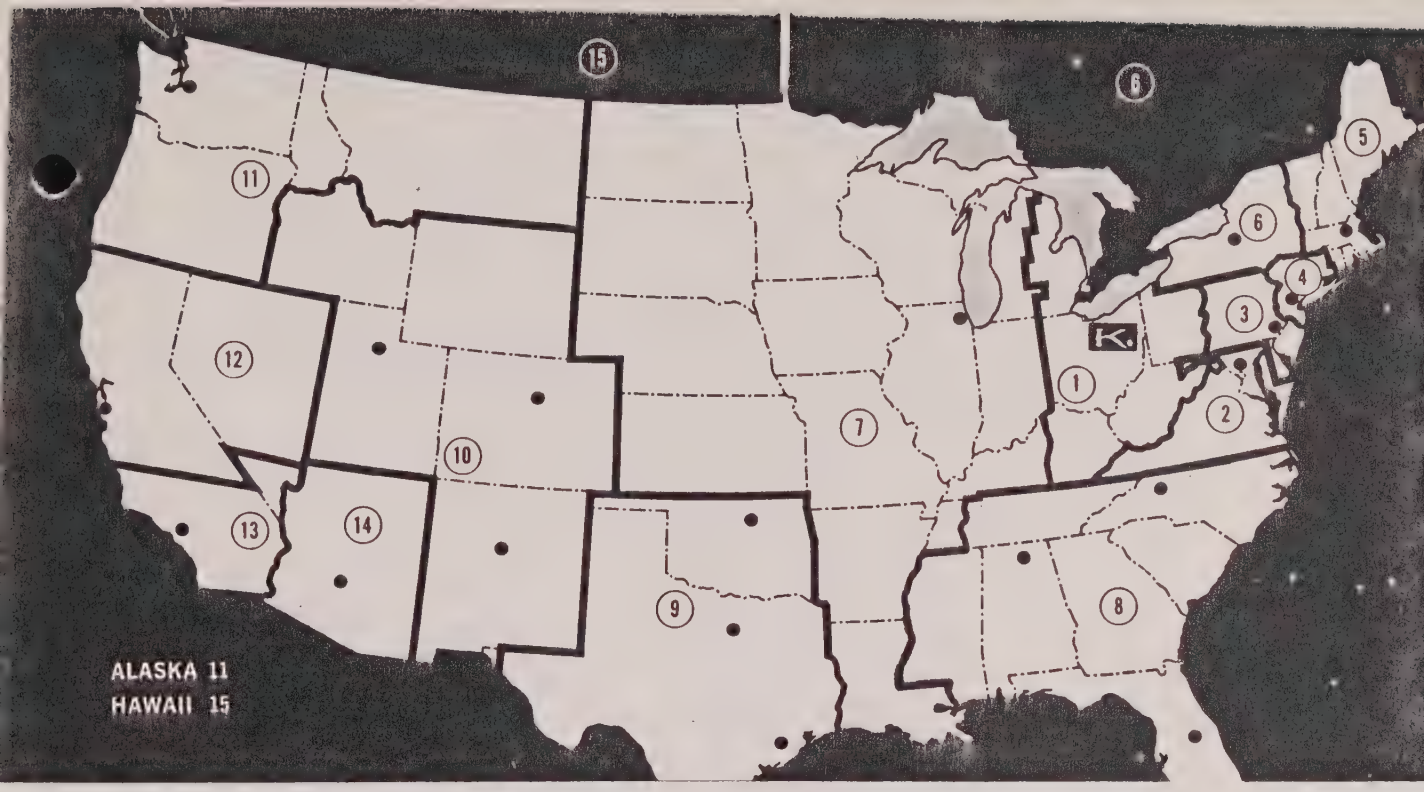

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15 NO REPRESENTATIVE
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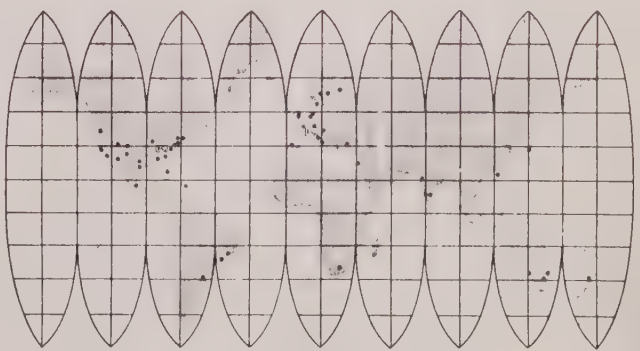
■ Authorized Service Center.

european services

A Keithley maintained warehouse and office in Lausanne, Switzerland, provides prompt delivery in the European area. The office, staffed by Keithley field engineering personnel, gives on-the-spot assistance to your Keithley representative so that he may better serve you.



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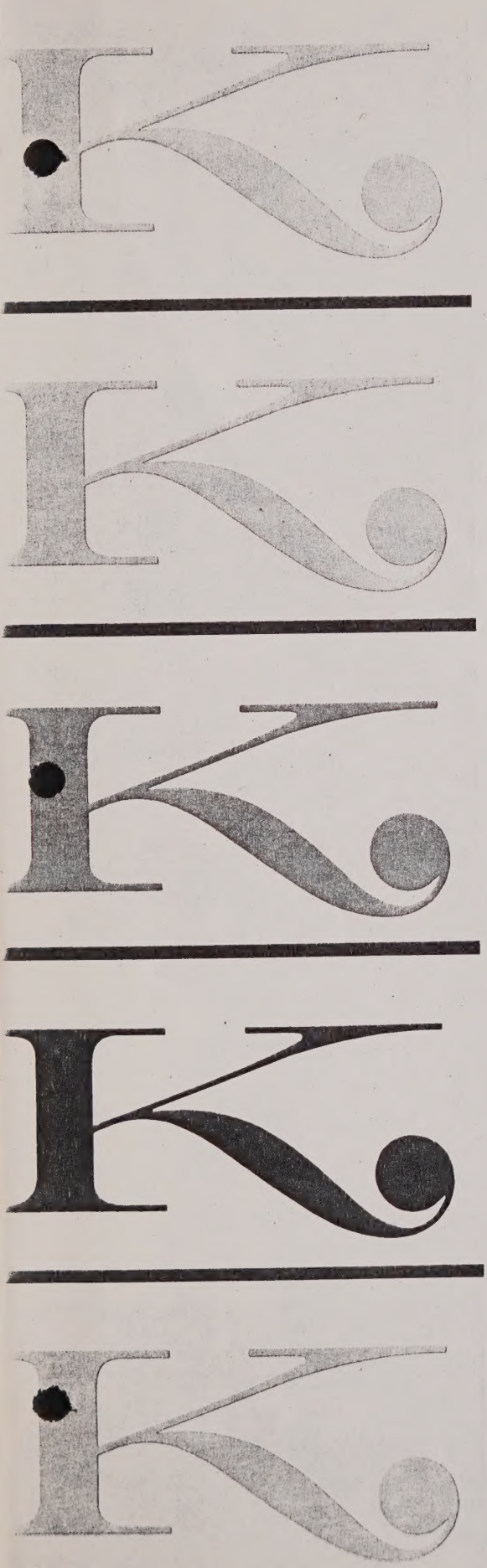

1967 CATALOG SUPPLEMENT

KEITHLEY
INSTRUMENTS, INC.

The 1967 Keithley Instruments Catalog Supplement contains representative specifications and complete prices for instruments and accessories as of January 1, 1967.